5.3.4 Questions Starting with "R" (for Riverine and Freshwater, Tidal Fringe Wetlands)

Water Quality and Hydrologic Functions in Riverine and Freshwater, Tidal Wetlands

R 1.0 Does the Wetland have the Potential to Improve Water Quality?

R 1.1 *Area of surface depressions within wetland that can trap sediments and associated pollutants during a flooding event*:

Rationale for indicator: Depressions in riverine wetlands will tend to accumulate sediment and the pollutants associated with sediment (phosphorus and some toxics) because they reduce water velocities (Fennessey et al. 1994), especially when the river floods. Wetlands where a larger part of the total area has depressions are relatively better at removing pollutants than those that have no such depressions.

For this question you will need to estimate the fraction of the wetland that is covered by depressions. Make a simple sketch of the wetland boundary, and on this superimpose the areas where depressions are found. From this you can make a rough estimate of the area that has depressions and determine if this is more than ¾ or more than ½ of the total area of the wetland. Standing or open water present in the wetland when the river is not flooding are good indicators of depressions. Figure 25 shows a riverine wetland with depressions filled with water.

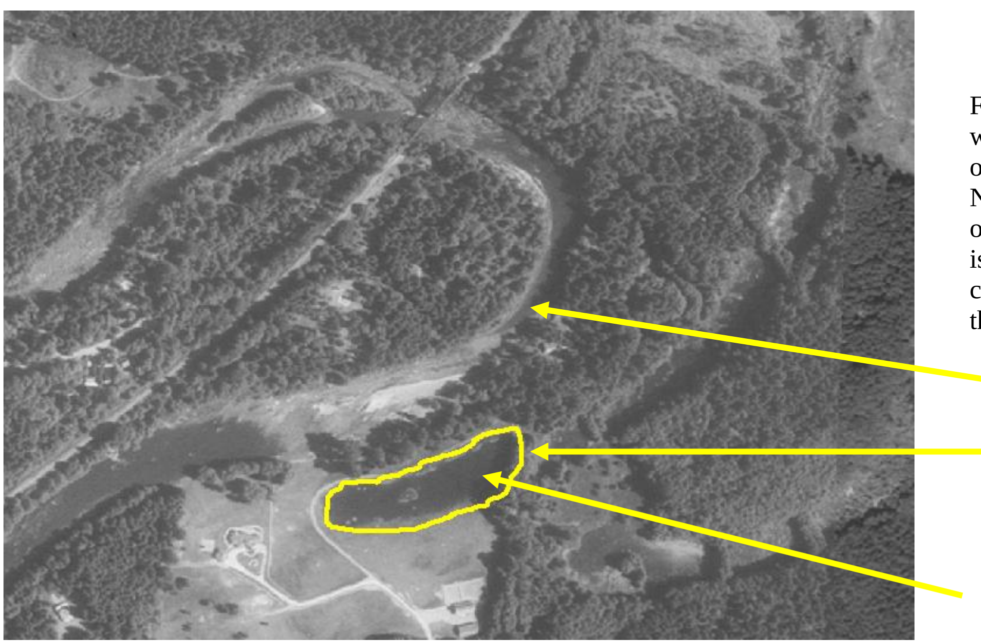


Figure 25: A riverine wetland in an old oxbow of the Nisqually River, with one big depression that is filled with water and covers more than ¾ of the wetland.

R 1.2 *Characteristics of the vegetation in the wetland:*

> **Rationale for indicator**: Vegetation in a riverine wetland will improve water quality by acting as a filter to trap sediments and associated pollutants. The vegetation also slows the velocity of water which results in the deposition of sediments. Persistent, multi-stemmed plants enhance sedimentation by offering frictional resistance to water flow (review in Adamus et al. 1991). Shrubs and trees are considered to be better at resisting water velocities than emergent plants during flooding and are scored higher. Aquatic bed species or grazed, herbaceous (non-woody) plants are not judged to provide much resistance to water flows and are not counted as "filters."

For this question you will need to group the vegetation found within the wetland into three categories – 1) Forest or shrub, 2) ungrazed emergent plants (> 6 inches high), and 3) neither forest, shrub nor un-grazed emergents.

There are two size thresholds used to score this characteristic – more than 2/3 of the wetland area is covered in either emergent, forest, or shrubby vegetation, and more than 1/3 is covered. These thresholds can usually be estimated visually in small wetlands. Large wetlands, however, may require you to draw the area of vegetation types on a map or aerial photo before you can feel confident that your estimates are accurate.

R 2.0 Does the Wetland Have the <u>Opportunity</u> to Improve Water Quality?

> **Rationale for indicator**: The opportunity for wetlands to improve water quality in a watershed is related to the amount of pollutants that come into the wetland. Qualitatively, the level of pollutants can be correlated with the level of disturbance, development, and intensity of agriculture in the landscape. For example, relatively undisturbed watersheds will carry much lower sediment and nutrient loads than those that have been impacted by development, agriculture, or logging practices (Hartmann et al. 1996, and Reinelt and Horner 1995). The opportunity that a wetland has to improve water quality is, therefore, linked to the amount of development, agriculture, or logging present in its immediate surroundings or in the up-gradient part of its contributing basin.
>
> For the purpose of rating, it is assumed that a wetland has the opportunity to improve water quality if the amount of pollutants coming into the wetland as a result of human activities is higher than the pollutants (sediment and nutrients) that would be coming from natural causes. It is the removal of this excess pollution that is considered to be a valuable function for society.

Answer YES if there are pollutants in groundwater or surface water coming into the wetland that would otherwise reduce water quality in streams, lakes or groundwater down-gradient from the wetland.

Users of the rating system must make a qualitative judgment on the opportunity of the riverine wetland to actually improve water quality by asking the question. Are there any sediments, nutrients, or toxic chemicals coming into the wetland from human activities that would otherwise reduce water quality in streams, lakes or groundwater down-gradient from the wetland? Pollutants can come into a riverine wetland through groundwater (if the wetland is a place where groundwater comes in from the sides of a river valley), surface runoff, or overbank flooding from a stream or river.

The question on the rating form lists several examples of conditions that result in pollutants reaching a wetland and therefore provide the opportunity for the wetland to improve water quality. You are asked to note which of the following conditions provide the sources of pollutants.

- Grazing in the wetland or within 150ft. The issue here is nutrients coming into the wetland from animal droppings from domesticated animals. The wetland has the opportunity to significantly improve water quality if you can see recent droppings from domesticated animals, and you judge that nutrients and bacteria from these can be washed into the wetland.
- Untreated stormwater flows into the wetland. Stormwater is a source of sediment and toxic compounds.
- Tilled fields or orchards within 150 feet of wetland. Agriculture is a source of pesticides, nutrients, and sediments. The input of these pollutants to the wetland can be either by surface runoff or windblown dust.
- A stream or culvert discharges water into a wetland from developed areas, residential areas, farmed fields, roads, or areas that have been clear-cut within the last five years. Streams or culverts can bring in pollutants that are released outside the immediate area of the wetland. If you find a stream or culvert coming into the wetland, you will need to trace the course of the stream and determine if it passes through areas that can release pollutants. Use topographic maps or aerial photos to confirm this observation.
- Land uses within 150 ft upslope of the wetland that generate pollutants (residential areas having more than 1 house per acre, urban areas, commercial areas, and golf courses). These areas potential source of pollutants from lawn care, driveways, pets, and parking lots.
- The river or stream adjacent to the wetland has a contributing basin where human activities have raised levels of sediment, toxic compounds or nutrients in the river water. These pollutants can reach the wetland during floods. Generally, a riverine wetland will have the opportunity to improve water quality if the adjacent river or stream does not meet standards for water quality. The list of waters that do not meet standards for water quality, as required under Section 303(d) of the federal Clean Water Act can be found at http://www.ecy.wa.gov/programs/wq/links/impaired_wtrs.html

The rating form has space to note potential sources of pollutants coming into the wetland from sources not mentioned above. If you observe or know of other sources, note this on the form.

R 3.0 Does the Wetland Have the Potential to Reduce Flooding and Stream Erosion?

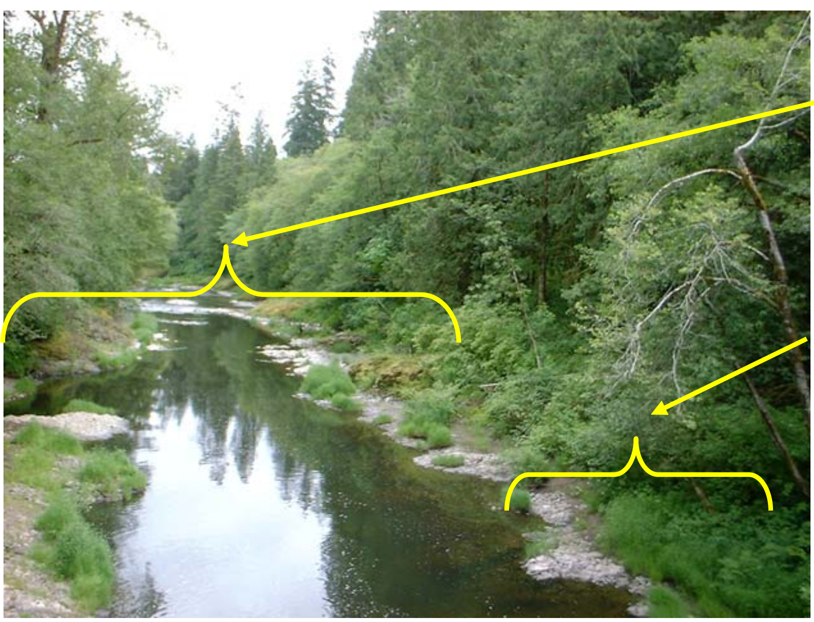
R 3.1 *Characteristics of the "overbank" flood storage the wetland provides, based on the ratio of the channel width to the width of the wetland:*

Rationale for indicator: The ratio of the width of the channel to the width of the wetland is an indicator of the relative volume of storage available within the wetland. The width of the stream between banks is a good indicator of the relative flows at that point in the watershed. Wider streams will have higher volumes of water than narrower streams. More storage is therefore needed in larger systems to lessen the impact of peak flows. The width of the wetland perpendicular to the stream is used as an indicator of the amount of short-term storage available during a flood event. A wetland that is wide relative to the width of the stream is assumed to provide more storage during a flood event than a narrow one. The ratio of the two values provides an estimate that makes it possible to rank wetlands relative to each other in terms of their overall potential for storage.

You will need to estimate the average width of the wetland perpendicular to the direction of the flow, and the width of the stream or river channel (distance between banks). In these areas calculate this ratio by taking the width of the wetland and dividing by the width of the stream. There are five thresholds for scoring: a ratio more than 20, a ratio between 10 – 20, a ratio between 5 – <10 , a ratio between 1 - <5, and a ratio < 1 .

Riverine wetlands are found in different positions in the floodplain and it may sometimes be difficult to estimate this indicator. The following bullets describe some common types of riverine wetland and how to estimate this indicator.

- If the vegetated wetland lies within the banks of the stream or river, the ratio is estimated as the average width of the "delineated" wetland / average distance between banks. Figure 26 shows a wetland where vegetation fills only a small part of the distance between the banks. In this case the ratio is < 1.



Distance between banks is approximately 100 ft.

Average width of wetland perpendicular to river flow is approximately 10 feet.

Figure 26. A riverine wetland where the width of the wetland is less than the distance between banks (< 1).

- If the wetland lies outside the existing banks of the river, you may need to estimate the distances using a map or aerial photograph. Riverine wetlands in old oxbows may be some distance away from the river banks. Instead of trying to estimate a width for the wetland and the distance between banks in feet or yards, it may be easier to estimate the ratio directly. Ask yourself if the average width of the wetland is more or less than the distance between banks. If it is more, is it more than five times as wide? If not, the ratio is between 1- <5. If it is more than five times greater, is it more than 10 times, etc. Figure 27 shows a riverine wetland in an old oxbow where the ratio was judged to be between 1- <5.

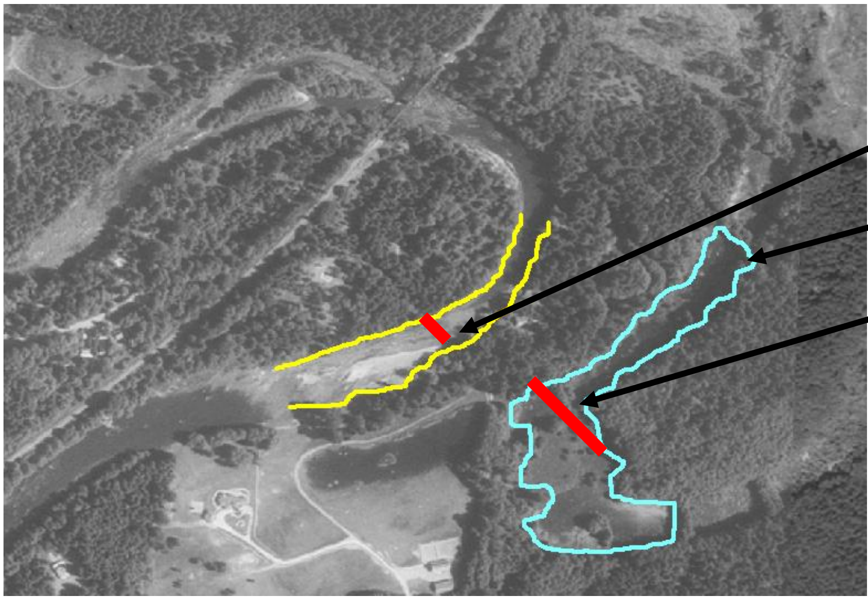


Figure 27: A riverine wetland in an old oxbow of the Nisqually River where the average width of the wetland is between 1-5 times the width of the river channel.

- If you are including the river or stream as part of the wetland (see p. 15), then the width of the stream is also included in the estimate of the width of the wetland.

R 3.2 *Characteristics of vegetation that slow down water velocities during floods:*

Rationale for indicator: Riverine wetlands play an important role during floods because their vegetation acts to slow water velocities and thereby erosive flows. This reduction in velocity also spreads out the time of peak flows, thereby reducing the maximum flows. The potential for reducing flows will be greatest where the density of wetland vegetation and other obstructions is greatest and where the obstructions are rigid enough to resist water velocities during floods (Adamus et al. 1991). The indicator used in the rating system combines both characteristics for the scoring. Shrubs and trees are considered to be better at resisting water velocities than emergent plants. Aquatic bed species are judged not to provide much resistance and are not counted. Wetlands with a dense cover of trees and shrubs are scored higher than those with only a cover of emergent species.

For this question you will need to group the vegetation found within the wetland into two categories – 1) emergent, and 2) forest and/or scrub/shrub. These categories of plants are based on the “Cowardin” classification of wetlands (see p. 34).

There are four size thresholds used to score this characteristic – 1) forest or shrub for more than 1/3 the area of the wetland, 2) emergent plants > 2/3 area, 3) forest or shrub for > 1/10 area, 4) emergent plants > 1/3 area. Figure 28 shows an aerial photograph of a riverine wetland that has dense shrub vegetation over most of its area.

NOTE: If the wetland is covered with downed trees, you can treat large woody debris as “forest or shrub.”

Figure 28**:** A riverine wetland in Bothell that has shrub vegetation over more than 1/3 of its area. Other important characteristics are: 1) the stream is part of the wetland because it is smaller than 50 ft. and there is wetland vegetation on both sides, 2) the average ratio of width of wetland to width of stream is greater than 20 (question R 3.1). Photo by Dan Crowell, Soundview Aerial Photography, Arlington, Wa 360-691-4419.

R 4.0 Does the Riverine Wetland Have the <u>Opportunity</u> to Reduce Flooding and Stream Erosion?

Rationale for the indicator: The opportunity for wetlands to reduce the impacts of flooding and erosion is based on the presence of human or natural resources that can be damaged by these processes. The indicators used characterize whether the wetland’s position in the landscape will allow it to reduce flooding. We ask if there are resources in the watershed that can be damaged by flooding and erosion. These resources include both human and natural ones.

Answer YES if the wetland is in a landscape position where the flood storage, or reduction in water velocity, it provides can reduce damage to downstream property and aquatic resources. Riverine wetlands are by definition directly linked to the active floodplain (receive overbank flooding at least once every two years), and thus have the opportunity to perform this function if there are resources that can be impacted by flooding.

This question requires you to consider the resources that might be impacted by flooding or erosive flows. Are there stream banks that might be eroded, structures that can be damaged, or natural resources that can be damaged in areas down-gradient from the wetland? A USGS topographic map is a good tool to use to answer this question. The map will show buildings, bridges, or other structures in the floodplain of a river or stream. An aerial photograph can also be useful to identify resources that might be impacted by increases in surface flows.

The landscapes in western Washington are quite varied and it may be difficult to judge whether a wetland has the opportunity to perform hydrologic functions. The following points are provided as a guide to help you answer this question.

- There are human structures and activities along the stream or river (roads, buildings, bridges, farms) that can be damaged by flooding.
- There are natural resources downstream (e.g. salmon redds) than can be damaged by flooding.
- Wetlands upslope of a state highway do not have opportunity to provide hydrologic functions if the road impounds surface water near the rated wetland during flood events and keeps it impounded for some time after the flood recedes.
- A wetland that is adjacent to, or discharges directly to large reservoirs where water levels are controlled does **not** have the opportunity to perform the hydrologic functions. The reservoir acts to buffer the impacts of the loss of water storage if a wetland were filled.

The rating form has space to note observations of resources that could be impacted by flooding not mentioned on the form. If you observe or know of other resources, note this on the form.

5.3.5 Questions Starting with "L" (for Lake-fringe Wetlands)

Water Quality and Hydrologic Functions in Lake-fringe Wetlands

L 1.0 Does the Lake-fringe Wetland have the Potential to Improve Water Quality?

NOTE: Lake-fringe wetlands have a maximum score of only 24 points for the water quality functions instead of 32. The technical review team concluded that lake-fringe wetlands do not improve water quality to the same extent as riverine or depressional wetlands because denitrification rates are reduced relative to other wetlands and any pollutants taken up in plant material will be more easily released into the water column when the plants die off.

L 1.1 *Average width of vegetation along the lakeshore*:

Rationale for indicator: The intent of this question is to characterize the width of the zone of plants that provide a vertical structure to trap or filter out pollutants or absorb them. Wetlands in which the average width of vegetation is large are more likely to retain sediment and toxic compounds than where vegetation is narrow (Adamus et al 1991). Even aquatic bed species that die back every year are considered to play a role in improving water quality. These plants take up nutrients in the spring and summer that would otherwise be available to stimulate algal blooms in the lake. In addition, aquatic bed species change the chemistry of the lake bottom to facilitate the binding of phosphorus (Moore et al. 1994).

It is difficult to map the outside edge of a wetland when it is along the shores of a lake where open water can extend out for large distances. For this reason the question is phrased in terms of width of vegetation perpendicular to the shore rather than the area of vegetation. There are three thresholds for scoring the average width of vegetation:

1) 33 ft or more (10m)
2) 16 ft - < 33 ft (5–10 m)
3) 6 ft - <16 ft. (2 – 5m)

For large wetlands along the shores of a lake it may be necessary to sketch the vegetation and average the width by segment, and then calculate an overall average. Figure 29 gives an example of such a sketch.

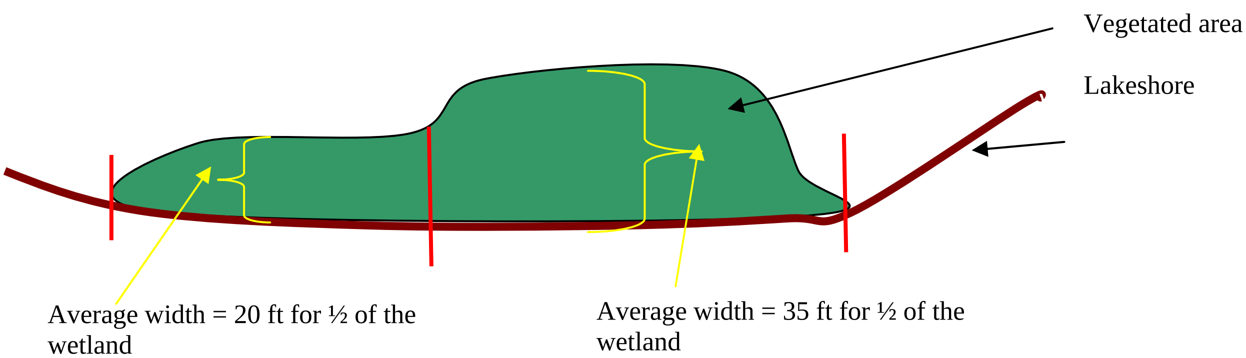


Figure 29: Estimating width of vegetation along the shores of a lake. The average width of vegetation for the entire area is: (20ft x 0.5) + (35 ft x 0.5) = 27.5 ft.

Figure 30 shows an actual lake-fringe wetland where the average width of vegetation is greater than 33 ft.

Figure 30: A lake-fringe wetlands where the vegetation is wider than 33 ft. The vegetation along the shores of this lake consists of a zone of shrubs and a zone of aquatic bed and emergent species.

L 1.2 *Characteristics of the vegetation in the wetland:*

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered with plants that are more effective at improving water quality in a lake environment. Herbaceous emergent species have, in general, been found to sequester metals and remove oils and other organics better than other plant species (Hammer 1989, and Horner 1992).

For this question you will need to group the vegetation found within the wetland into three categories – 1) herbaceous, 2) aquatic bed and 3) any other vegetation. For this question, the herbaceous plants can be either the dominant plant form (in this case it would be called emergent class) or as an understory in a shrub or forest community).

There are several size thresholds used to score this characteristic – more than 90%, more than 2/3, or more than 1/3, of the vegetated area is covered in herbaceous plants or other types. These thresholds can usually be estimated visually in small wetlands. Large wetlands, however, may require you to draw the area of vegetation types on a map or aerial photo before you can feel confident that your estimates are accurate.

NOTE: In lake-fringe wetlands the area of the wetland used as the basis for determining thresholds is only the area that is vegetated. Do not include any open water in determining the area of the wetland covered by a specific vegetation type.

L 2.0 Does the Lake-fringe Wetland Have the <u>Opportunity</u> to Improve Water Quality?

Rationale for indicator: The opportunity for lake-fringe wetlands to improve water quality can be correlated with the amount of pollutants discharged into the lake, or watershed upstream of the lake, on which the wetland is found. For example, relatively undisturbed watersheds will carry much lower sediment and nutrient loads than those that have been impacted by development, agriculture, or logging practices (Hartmann et al. 1996, and Reinelt and Horner 1995).

Answer YES if the wetland is on the shores of a lake where water quality is a problem. Generally, a lake-fringe wetland will have the opportunity to improve water quality if the adjacent lake does not meet water quality standards. The list of waters in which water quality standards are not met, as required under Section 303(d) of the federal Clean Water Act can be found at
http://www.ecy.wa.gov/programs/wq/links/impaired_wtrs.html

In addition, users of the rating system must make a qualitative judgment on the opportunity of the lake-fringe wetland to actually improve water quality by asking the question. Are there any sediments, nutrients, or toxic chemicals coming into the wetland from the surrounding uplands that would otherwise reduce water quality in the adjacent lake? Pollutants can come into a wetland in groundwater or surface water discharging through the wetland to the lake. The following conditions give some examples of conditions that result in pollutants reaching a wetland and therefore provide the opportunity for the wetland to improve water quality.

- Grazing in the wetland or within 150 ft. of the wetland (input of coliform bacteria and nutrients from surface runoff)
- Untreated stormwater flows through the wetland (input of sediment and toxic compounds)
- Tilled fields or orchards within 150 feet of wetland (input of pesticides, sediment, and nutrients: input is either by surface runoff or windblown dust)
- A stream or culvert discharges water into wetland from developed areas, residential areas, farmed fields, or clear-cut logging (input of toxic compounds, sediments, nutrients).
- Land uses within 150 ft upslope of the wetland that generate pollutants (residential areas having more than 1 house per acre, urban areas, commercial areas, and golf courses). These areas are potential source of pollutants from lawn care, driveways, pets, and parking lots.
- Lakes with moderate to heavy use by powerboats, or the lake-fringe wetland is next to a boat launching ramp.

The rating form has space to note potential sources of pollutants coming into the wetland from sources not mentioned above. If you observe or know of other sources, note this on the form.

L 3.0 Does the Lake-fringe Wetland Have the <u>Potential</u> to Reduce Shoreline Erosion?

NOTE: Lake-fringe wetlands have a maximum score of only 12 points for the hydrologic functions instead of 32. The technical review team concluded that lake-fringe wetlands do not provide hydrologic functions to the same extent as riverine or depressional wetlands. The function of reducing shoreline erosion at the local scale was not judged to be as important as reducing peak flows and reducing erosion at the watershed scale, and should not be scored as highly.

L. 3.1 *Average width, and characteristics, of vegetation along the lakeshore (do not include aquatic bed species*):

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered with plants that provide a physical barrier to waves and protect the shore from erosion. This protection consists of both shoreline anchoring and the dissipation of erosive forces (Adamus et al. 1991). Wetlands that have extensive, persistent (especially woody) vegetation provide protection from waves and currents associated with large storms that would otherwise penetrate deep into the shoreline (Adamus et al 1991). Emergent plants provide some protection but not as much as the stiffer shrubs and trees.

This characteristic is similar to that used in L1.1 and L1.2, but the grouping of vegetation types and thresholds for scoring are different. If you are familiar with the Cowardin classification of vegetation you are looking for the areas that would be classified as "Scrub/shrub," "Forested," or "Emergent."

It is difficult to map the outside edge of a wetland when it is along the shores of a lake where open water can extend out for large distances. For this reason the question is phrased in terms of the width and type of vegetation found only within the area of shrubs, trees, and emergents. There are two thresholds for measuring the average width of vegetation [33 ft (10m) and 6 ft (2m)], and two thresholds based on area [3/4 and ¼ of the vegetated areas]. For large wetlands along the shores of a lake it may be necessary to sketch the vegetation types and average the width by type. Figure 31 gives an example of such a sketch.

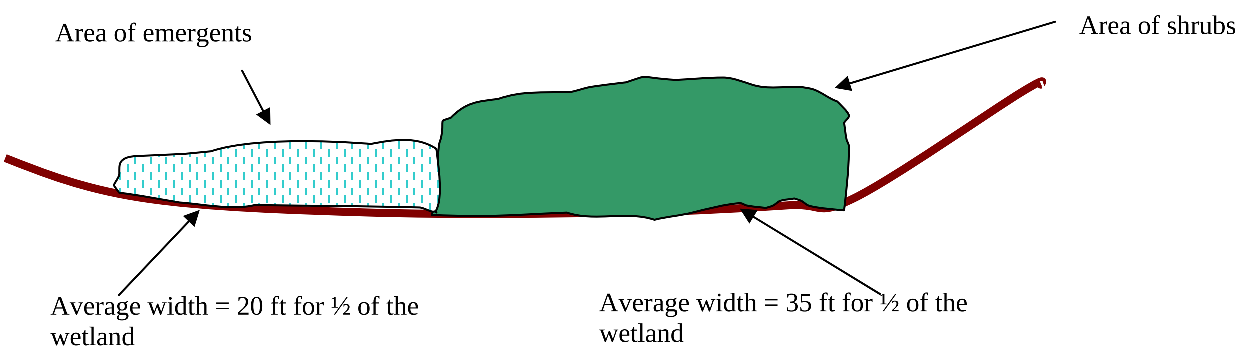


Figure 31: Estimating width of vegetation types along the shores of a lake. The average width of shrubs is 35 ft for ½ the wetland and emergents is 20 ft for ½ of the wetland. This wetland would score 4 points because more than 1/4 of the vegetation is shrubs greater than 33ft. wide.

L 4.0 Does the Lake-fringe Wetland Have the Opportunity to Protect Resources from Shoreline Erosion?

> **Rationale for indicator**: Lake-fringe wetlands have the opportunity to protect a shoreline from erosion if there is some resource that could be impacted by this erosion. For example, houses are often built along a shoreline, and these can be damaged by shoreline erosion, especially if the house is on a bluff. Buildings, however, are not the only resource that can be impacted. A mature forest along the shores of a lake is an important natural resource that provides important habitat. Shoreline erosion, especially man-made erosion from boat wakes, may topple trees into the lake and reduce the overall area of this resource.

Answer YES if there are features along the shore next to the wetland that will be impacted if the shoreline erodes.

Users of the rating system must make a qualitative judgment on the opportunity of the lake-fringe wetland protect resources from shoreline erosion. Generally, a lake-fringe wetland does have the opportunity if:

- There are human structures and activities along the shore behind the wetland (buildings, fields) that can be damaged by erosion.
- There are natural resources along the shore (e.g. mature forests other wetlands) behind the lake-shore wetland than can be damaged by shoreline erosion.

The rating form has space to note observations of resources along the shore that do not meet the criteria above. If you observe or know of other resources, note this on the form.

5.3.6 Questions Starting with "S" (for Slope Wetlands)

Water Quality and Hydrologic Functions in Slope Wetlands

S 1.0 Does the Slope Wetland have the Potential to Improve Water Quality?

NOTE: Slope wetlands have a maximum score of only 18 points for the water quality functions instead of 32. The technical review team concluded that lake-fringe wetlands do not improve water quality to the same extent as riverine or depressional wetlands because slope wetlands will tend to release water rather than trap it relative to other wetlands. The can be expected to be less effective at trapping sediment and all the pollutants associated with sediment.

S 1.1 *Characteristics of the average slope of the wetland:*

Rationale for indicator: Water velocity decreases with decreasing slope. This increases the retention time of surface water in the wetland and the potential for retaining sediments and associated toxic pollutants. The potential for sediment deposition and retention of toxics by burial increases as the slope decreases (review in Adamus et al. 1991).

For this question you will need to estimate the average slope of the wetland. Slope is measured either in degrees or as a percent (%). In this rating system we use the latter measurement, (%), which is calculated as the ratio of the vertical change between two points and the horizontal distance between the same two points [vertical drop in feet (or meters) / horizontal distance in feet (or meters)]. For example, a 1 foot drop in elevation between two points that are 100 ft. apart is a 1% slope, and a 2 foot drop in the same distance is a 2% slope.

For large wetlands the slope can be estimated from USGS topographic maps of the area. The change in contour lines can be used to calculate the vertical drop between the top and bottom edges of the wetland. The horizontal distance can be estimated using the appropriate scale (printed at the bottom of the map). Local jurisdictions sometimes have assessor's maps that are contoured at 2 ft intervals. These can be very useful in estimating the slope.

For small wetlands it will be necessary to estimate the vertical drop visually and the horizontal distance by pacing or using a tape measure. Visual estimates of the vertical drop are more accurate if you can find a point of reference near the bottom edge of the wetland. Stand at the upper edge of the wetland and visualize a horizontal line to a tree, telephone pole, or another person at the lower edge of the slope wetland. The point at which the "imaginary" horizontal line intersects the object at the lower edge can be used to estimate the vertical drop between the upper and lower edges of the wetland (see Figure 32).

NOTE: If you are standing at the upper edge of the wetland looking for a visual marker at the lower edge, do not forget to subtract your height from the total.

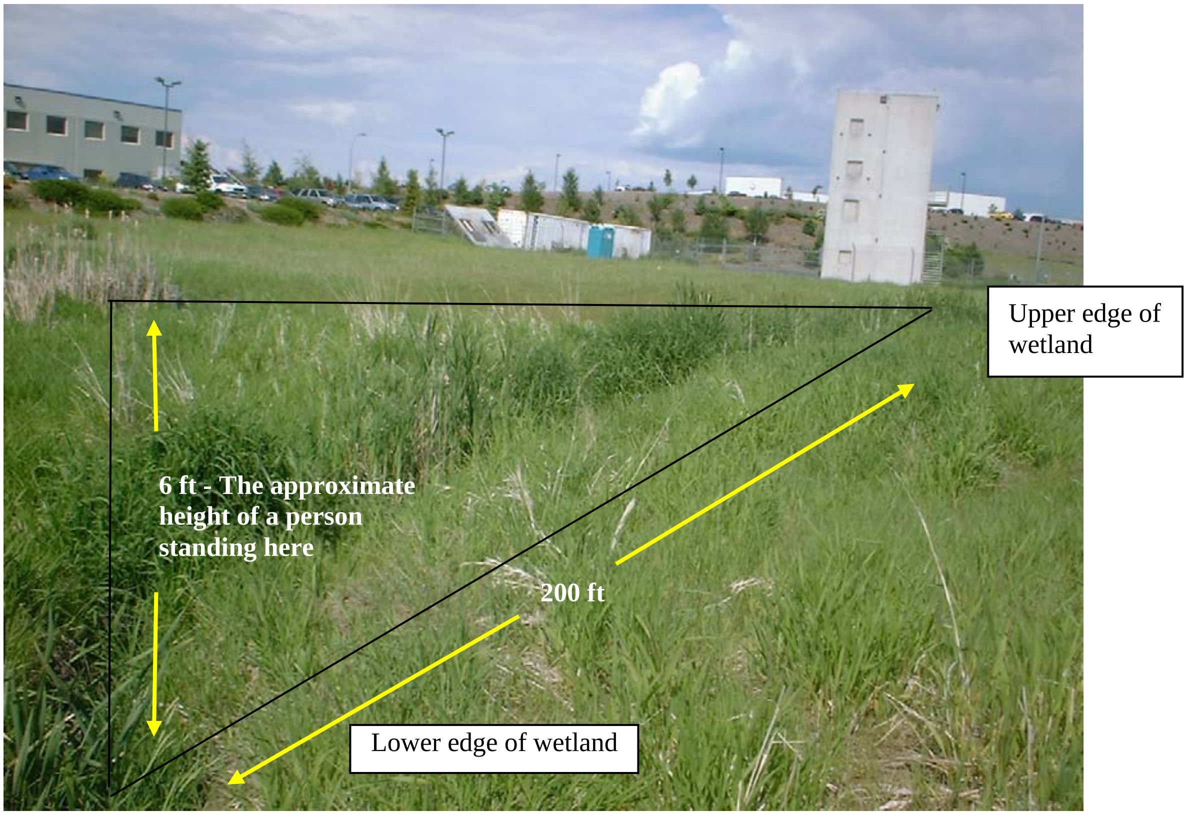


Figure 32. Estimating the slope of a small "slope" wetland. The top of a six foot person is about level with the upper edge of the wetland. The average slope is approximately 6/200 = 0.03 or 3%.

***S 1.2** The soil 2 inches below the surface is clay, organic, or smells anoxic (hydrogen sulfide or rotten eggs).*

Rationale for indicator: Clay soils, organic soils, and periods of anoxia in the soils are good indicators that a wetland can remove a wide range of pollutants from surface water. The uptake of dissolved phosphorus and toxic compounds through adsorption to soil particles is highest when soils are high in clay or organic content (Mitsch and Gosselink 1993). Anoxic conditions (oxygen absent), on the other hand, are needed to remove nitrogen from the aquatic system. This process, called denitrification, is done by bacteria that live only in the absence of oxygen (Mitsch and Gosselink 1993).

To look at the soil, dig a small hole within the wetland boundary and pick up a sample from a location that is about 2 inches below the surface. Usually it is best to sample the soil toward the middle of the wetland rather than at the edge. Avoid picking up any of the "duff" or recent plant material that lies on the surface. First smell the soil and determine if it has a smell or hydrogen sulfide (rotten eggs). If so, you have answered the question. If the soil is not anoxic, determine if the soil is organic or clay. If you are unfamiliar with the methods for doing this, a key is provided in Appendix C.

S 1.3 *Characteristics of the vegetation that trap sediments and pollutants:*

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered with plants that are more effective at improving water quality in a slope environment. Herbaceous species have, in general, been found to sequester metals and remove oils and other organics better than other plant species (Hammer 1989, and Horner 1992). Furthermore, dense herbaceous vegetation presents the greatest resistance to the surface flow often found on slope wetlands. Water in this environment tends to flow very close to the surface and be shallow (not more than a few inches). Trees and shrubs tend to be widely spaced relative to herbaceous plants and don't provide as much resistance to this type of surface flow.

For this question you will need to group the vegetation found within the wetland into only two groups: dense, ungrazed, herbaceous vegetation and all other types (Figure 33). NOTE: **The Cowardin vegetation types are not used for this question.** For this question the herbaceous vegetation includes the areas of "emergent" vegetation as classified by Cowardin and the herbaceous understory in a shrub or forest. To qualify for "dense" the herbaceous plants must cover at least ¾ (75%) of the ground (as opposed to the 30% requirement in the Cowardin vegetation types).

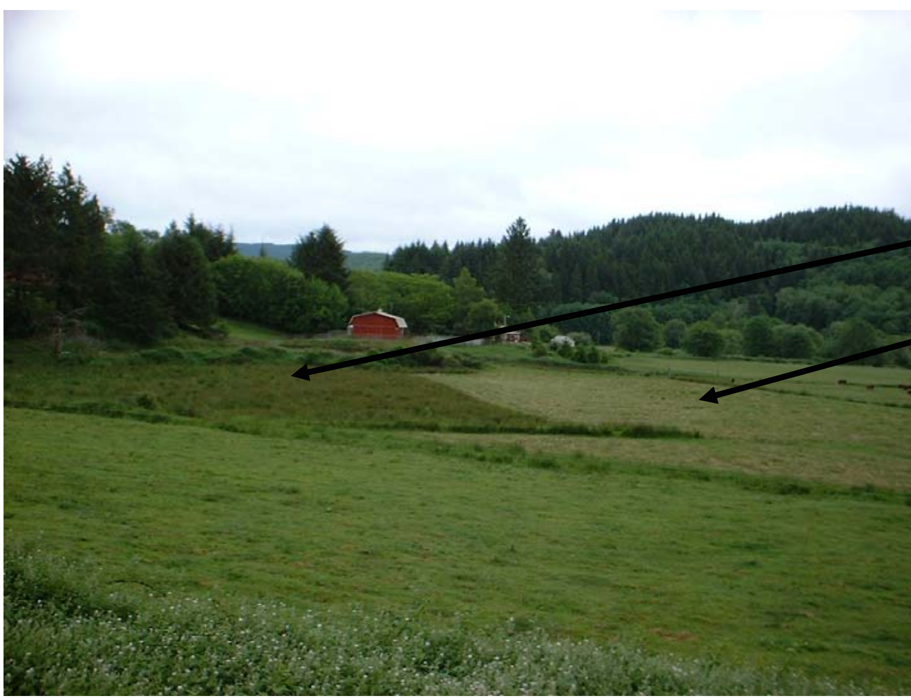


Figure 33: A slope wetland where dense unmowed, vegetation is between 1/4 and 1/2 the area of the wetland.

Unmowed part of the wetland covered by *Juncus* sp.

Mowed part of wetland.

S 2.0 Does the Slope Wetland Have the <u>Opportunity</u> to Improve Water Quality?

> **Rationale for indicator**: The opportunity for wetlands to improve water quality in a watershed is related to the amount of pollutants that come into the wetland. Qualitatively, the level of pollutants can be correlated with the level of disturbance, development, and intensity of agriculture in the landscape. The opportunity that a slope wetland has to remove sediment and nutrients is, therefore, linked to the amount of development, agriculture, or logging present in the areas that might contribute surface water or groundwater to the wetland. For example, cattle in the wetland or in a pasture uphill of the wetland will introduce nutrients and coliform bacteria to surface runoff going through the wetland. Cattle in a field downslope from the wetland, however, will not introduce pollutants that the wetland can remove.

Answer YES if there are pollutants in groundwater or surface water coming into the wetland that would otherwise reduce water quality in streams, lakes or groundwater downgradient from the wetland.

Users of the rating system must make a qualitative judgment on the opportunity of the depressional wetland to actually improve water quality by asking the question. Are there any sediments, nutrients, or toxic chemicals coming into the wetland that would otherwise reduce water quality in streams, lakes or groundwater downgradient from the wetland? Pollutants can come into a wetland both through groundwater and surface runoff. The question on the rating form lists several examples of conditions that result in pollutants reaching a wetland and therefore provide the opportunity for the wetland to improve water quality.

You are asked to note which of the following conditions provide the sources of pollutants.

- Grazing in the wetland or within 150ft. The issue here is nutrients coming into the wetland from animal droppings, from domesticated animals. The wetland has the opportunity to improve water quality if you can see recent droppings from domesticated animals, and you judge that nutrients and bacteria from these can be washed into the wetland.
- Tilled fields or orchards within 150 feet of wetland. Agriculture is a source of pesticides, nutrients, and sediments. The input of these pollutants to the wetland can be either by surface runoff or windblown dust.
- Land uses within 150 ft upslope of the wetland that generate pollutants (residential areas having more than 1 house per acre, urban areas, commercial areas, and golf courses). These areas are a potential source of pollutants from lawn care, driveways, pets, and parking lots.

The rating form has space to note potential sources of pollutants coming into the wetland from sources not mentioned above. If you observe or know of other sources, note this on the form.

S 3.0 Does the Slope Wetland Have the Potential to Reduce Flooding and Stream Erosion?

NOTE: Slope wetlands have a maximum score of only 12 points for the hydrologic functions instead of 32. The technical review team concluded that slope wetlands may provide some velocity reduction but do not provide flood storage. Thus they should be scored less than wetlands that can perform both aspects of the function.

S 3.1 *Characteristics of vegetation that reduce the velocity of surface flows.*

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered with plants that provide a physical barrier to sheetflow coming down the slope. Vegetation on slopes will reduce peak flows and the velocity of water during a storm event (U.S. Geologic Service, http://ga.water.usgs.gov/edu/urbaneffects.html , accessed July 31, 2003). The importance of vegetation on slopes in reducing flows has been well documented in studies of logging (Lewis et al. 2001) though not specifically for slope wetlands. The assumption is that vegetation in slope wetlands plays the same role as vegetation in forested areas in reducing peak flows.

For this question you will need to estimate the area of two categories of vegetation found within the wetland: dense, uncut, rigid vegetation and all other vegetation. This indicator of vegetation is **not** related to any of the Cowardin classes. **Dense** means that individual plants are spaced closely enough that the soil is barely, if at all, (> 75% cover of plants) visible when looking at it from the height of an average person. **Uncut,** means that the height of the vegetation has not been significantly reduced by grazing or mowing. "Significantly reduced" means that the height is less than 6 inches. **Rigid** is defined as having stems thick enough (usually > 1/8 in.) to remain erect during surface flows.

There are three size thresholds used to score this characteristic: dense, ungrazed, erect vegetation for more than 90% of the area of wetland (see Figure 34), ½ the area, and ¼ the area. The wetland in Figure 33 was mowed over much of its area, except where the *Juncus sp.* was growing. The mowed vegetation was less than 6 in. high, so the only plants that were included for this indicator were the *Juncus*. The wetland in Figure 33 has between ¼ and ½ of its area with dense, unmowed, erect vegetation.

Figure 34: A slope wetland with dense erect, ungrazed vegetation (reed canary grass and *Juncus* sp., shrubs and trees) over more than 90% of its area. The direction of the slope is from the left of the photograph to the right. The arrow points in the direction of water flow.

S 3.2 *Characteristics of slope wetlands that hold back small amounts of flood flows:*

Rationale for indicator: The intent of this question is to characterize how much of the wetland is covered by small depressions that can hold back surface flows. Depressions are an important indicator of the ability to retain flood-waters (review in Adamus et al. 1991). Slope wetlands usually do not have large depressions within their boundaries, but several slope wetlands in western Washington were found with small depressions that were judged to be large enough to provide some water retention (2 ft across and 6-10 inches deep).

To answer this question you will have to walk throughout the wetland and note the micro-topography of the surface. If the slope wetland has depressions they will usually be dispersed throughout most of the wetland area. Depressions may be found near clumps of different vegetation, boulders, or in swales where the slope changes (Figure 35). Heavily grazed slope wetlands often have small depressions created by the cattle. For this question you will need to estimate if the depressions cover more or less than 10% of the total wetland area.

Figure 35: Slope wetland with numerous small depressions created by changes in slope and hummocks of plants. The depressions in the wetland covered about 15-20% of the wetland and met the criterion of >10% of the area.

S 4.0 Does the Slope Wetland Have the Opportunity to Reduce Flooding and Erosion?

Rationale for indicator: At first glance, it may be difficult to understand how slope wetlands even perform the hydrologic functions, and thus have an opportunity. Consider, however, a case where the slope wetland is covered with a parking lot. Surface runoff will leave the parking lot much faster than if the area is covered with a dense growth of plants. It is the physical structure provided by plants and small depressions that act to retard surface flows. These physical structures in turn protects resources that are downhill or downstream of the wetland. Slope wetlands have the opportunity to perform the hydrologic functions if there are resources downgradient that can be impacted by flooding or erosive flows.

Answer YES if the wetland is in a landscape position where the reduction in water velocity it provides can reduce damage to downstream property and aquatic resources.

Users of the rating system must make a qualitative judgment on the opportunity of the slope wetland has to protect resources from flooding and erosive flows. Generally, a slope wetland does have the opportunity if:

- Wetland has surface runoff that drains to a river or stream that has problems with floods
- There are resources downhill of the wetland that might be damaged by

excessive flows

NOTE: Slope wetlands do not have the opportunity if the following conditions are present because the wetland receives very little surface water:

- The major source of water is a groundwater seep fed or created by high groundwater resulting from irrigation practices.
- The major source of water is a groundwater seep controlled by a reservoir (e.g. a seep that is on the downstream side of a dam)